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Spectrographs for Field Decoding Work - Final Report

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(None)

(None)

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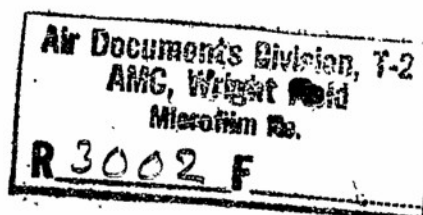
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The development and principle of operation of the sound spectrograph for field decoding work are outlined. The sound spectrograph is a device which automatically analyzes the distribution of energy in a sample of complex wave as a function of both frequency and time. The resultant spectrogram plots frequency along the vertical axis and time along the horizontal axis, and indicates amplitude by the density or blackness of the spectrogram patterns. Such three-dimensional analyses are particularly useful in providing visual interpretation of complex phenomena which vary from moment to moment. The weights and over-all dimensions of each unit of the sound spectrograph are given.

Copies of this report obtainable from CADO.

**Electronics (3)
Communications (1)**

Spectrographs, Sound (87778)



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NATIONAL DEFENSE RESEARCH COMMITTEE
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
DIVISION 13 SECTION 3 OSRD-P-5329

OEMsr - 1110

No. 63689

FINAL REPORT

PROJECT 13.3-86

SPECTROGRAPHS FOR FIELD DECODING WORK

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COMMUNICATIONS DIVISION
NATIONAL DEFENSE RESEARCH COMMITTEE
OF THE
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
FINAL REPORT
PROJECT 13.3-86
"SPECTROGRAPHS FOR FIELD DECODING WORK"

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Date of Preparation: MAY 30, 1944

Contract No. OEMsr-1110
Expiration Date of Contract: MAY 31, 1944

Contractor: Western Electric Co., Inc.
120 Broadway
New York, New York

Serial No. 32

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COMMUNICATIONS DIVISION
NATIONAL DEFENSE RESEARCH COMMITTEE
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FINAL REPORT
PROJECT 13.3-86

"SPECTROGRAPHS FOR FIELD DECODING WORK"

May 30, 1944

SUMMARY

At a meeting of the Section on Speech Secrecy (13.3) on February 15, 1943, it was recommended that the Sound Spectrograph, which had been used in Projects C-32 and C-43 for decoding speech codes, be re-designed for field use and included in field decoding kits at radio intercept stations. Subsequently it was decided to construct eight Sound Spectrographs; three for the U. S. Army (SC-28), three for the U. S. Navy (BuShips) and two for the British (Lend-Lease Requisition No. 17855, Prod. 288). Two copies of Operating and Maintenance Instructions were to be supplied with each Sound Spectrograph and one copy for the N.D.R.C. files.

Eight D-165529 Sound Spectrographs have been constructed and delivered together with the required Operating and Maintenance Instructions to the organizations noted above.

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COMMUNICATIONS DIVISION
NATIONAL DEFENSE RESEARCH COMMITTEE

FINAL REPORT - PROJECT 13.3-86
"SPECTROGRAPHS FOR FIELD DECODING WORK"

May 30, 1944

This report covers work carried out for the National Defense Research Committee under Contract No. OEMsr-1110 with the Western Electric Company, Inc., by the Bell Telephone Laboratories, Inc.

The Sound Spectrograph was first applied to the problem of decoding speech codes on N.D.R.C. Project C-32 and was continued on this work under Project C-43. Experience gained with three laboratory models of the Sound Spectrograph resulted in the recommendation, at a meeting of Section 13.3 of N.D.R.C. on February 15, 1943, that this device be re-designed for field use and included in field decoding kits at radio intercept stations. The military personnel present at the above meeting indicated that they were interested in obtaining six Sound Spectrographs for decoding work; three for the Army (SC-28) and three for the Navy (BuShips). Subsequently the number of Sound Spectrographs to be furnished under this project was increased from six to eight. The additional two Sound Spectrographs were allotted to the British on Lend-Lease Requisition No. 17855, Prod. 288.

The Sound Spectrograph is a device which automatically analyzes the distribution of energy in a sample of a complex wave as a function of both frequency and time. The result, displayed in graphic form, is called a spectrogram. Frequency is portrayed along the vertical axis, time along the horizontal axis and intensity or amplitude by the density or blackness of the spectrogram pattern. Such three-dimensional analyses are particularly useful in providing visual interpretation of complex phenomena which vary from moment to moment.

The operation of the Sound Spectrograph is basically simple. A sample of speech or other complex wave is recorded on a loop of magnetic tape and then reproduced repeatedly. The source of the sample may be the output of a microphone, phonograph pickup, radio receiver, etc. Each reproduction is scanned

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with a narrow band pass filter which is effectively shifted slightly in frequency with each repetition. Either of two scanning filters may be selected, one for a 45-cycle and the other for a 500-cycle band analysis. The output of the scanning filter is recorded continuously on dry facsimile paper wrapped around a drum rotating in synchronism with the magnetic tape. The recording stylus is shifted gradually along the frequency scale, at the rate of 96 lines per inch, in step with the filter. As the output of the filter fluctuates, the mark on the paper is made correspondingly lighter or darker, so that regions where the energy is greatest show black areas on the record and regions of no energy show the original light colored surface of the paper.

The spectrograms (Photograph 122605) are slightly over 12 inches long which normally represents 2.4 seconds, making the time scale about 200 milliseconds to the inch. They are normally 2 inches high, covering 3500 cycles, making the frequency scale about 1/16 inch per 100 cycles. If desired, however, the spectrograms can be made to cover a frequency range of about 11 kc, in which case the sample will be only 0.8 second long instead of 2.4 seconds. About 2-1/2 minutes are required to produce such spectrograms. In either case the frequency dimension can be expanded to 4 inches instead of 2 inches. About 5 minutes are required to produce such spectrograms.

Eight D-165529 Sound Spectrographs were constructed under this project. While basically the same as the earlier laboratory models, many improvements have been incorporated as a result of a considerable amount of research and development work. The units have been designed to be rugged and portable so that they may be used in the field. Each Sound Spectrograph consists of three units: a Recorder, an Amplifier-Analyzer and a Rectifier. These are shown on a table (not furnished) in Photograph 120238. Each unit is housed in a sheet steel case to provide protection and shock mounting during shipment and operation. The Amplifier-Analyzer and Rectifier units may be used in their steel cases or the cases may be removed and the units mounted on a relay rack. The Recorder unit is designed for use on a bench or table. In addition a spare parts box and spare parts have been provided with each Sound Spectrograph.

The power supply normally required is about 300 watts at 60 cycles 115 volts. Certain units have been designed to operate from a 50 cycle 115 volt source and are so marked. Operation from a 230 volt source requires an external transformer.

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The weights and overall dimensions of each unit of the D-165529 Sound Spectrograph ready for packing are given below:

<u>Unit</u>	<u>Weight</u>	<u>Dimensions (Inches)</u>
Recorder*	68 lbs.	17-1/2 x 16-1/2 x 11-3/4
Amplifier Analyzer	64 lbs.	20-1/4 x 11-1/4 x 14-1/4
Rectifier	56 lbs.	20-1/4 x 11-1/4 x 10-3/4

*NOTE The superstructure when assembled on the Recorder increases the height from 11-3/4" to 21-3/4" and increases the weight to approximately 84 lbs.

The Operating and Maintenance Instructions covering the D-165529 Sound Spectrograph describe in detail the various parts of the Sound Spectrograph, give directions for assembling the units, details of operation, routine maintenance, special maintenance, and preparation for shipment. Circuit and schematic drawings, photographs of the equipment in various stages of assembly, and tables, listing spare parts, suppliers and other information are a part of the Operating and Maintenance Instructions.

As directed by the Technical Aide of Division 13 (Dr. A. F. Murray) the eight D-165529 Sound Spectrographs constructed under this project were delivered as follows:

<u>To:</u>	<u>Number</u>	<u>Date</u>
U.S. Navy (Comdr. H.T. Engstrom)	One	January 3, 1944
U.S. Navy (Comdr. H.T. Engstrom)	One	March 17, 1944
U.S. Signal Corps (Lt. D.F. Hoth)	Three	April 21, 1944
U.S. Navy (Comdr. H.T. Engstrom)	One	April 25, 1944
British Ministry of Supply Mission (Mr. V. B. Redman)	Two	May 10, 1944

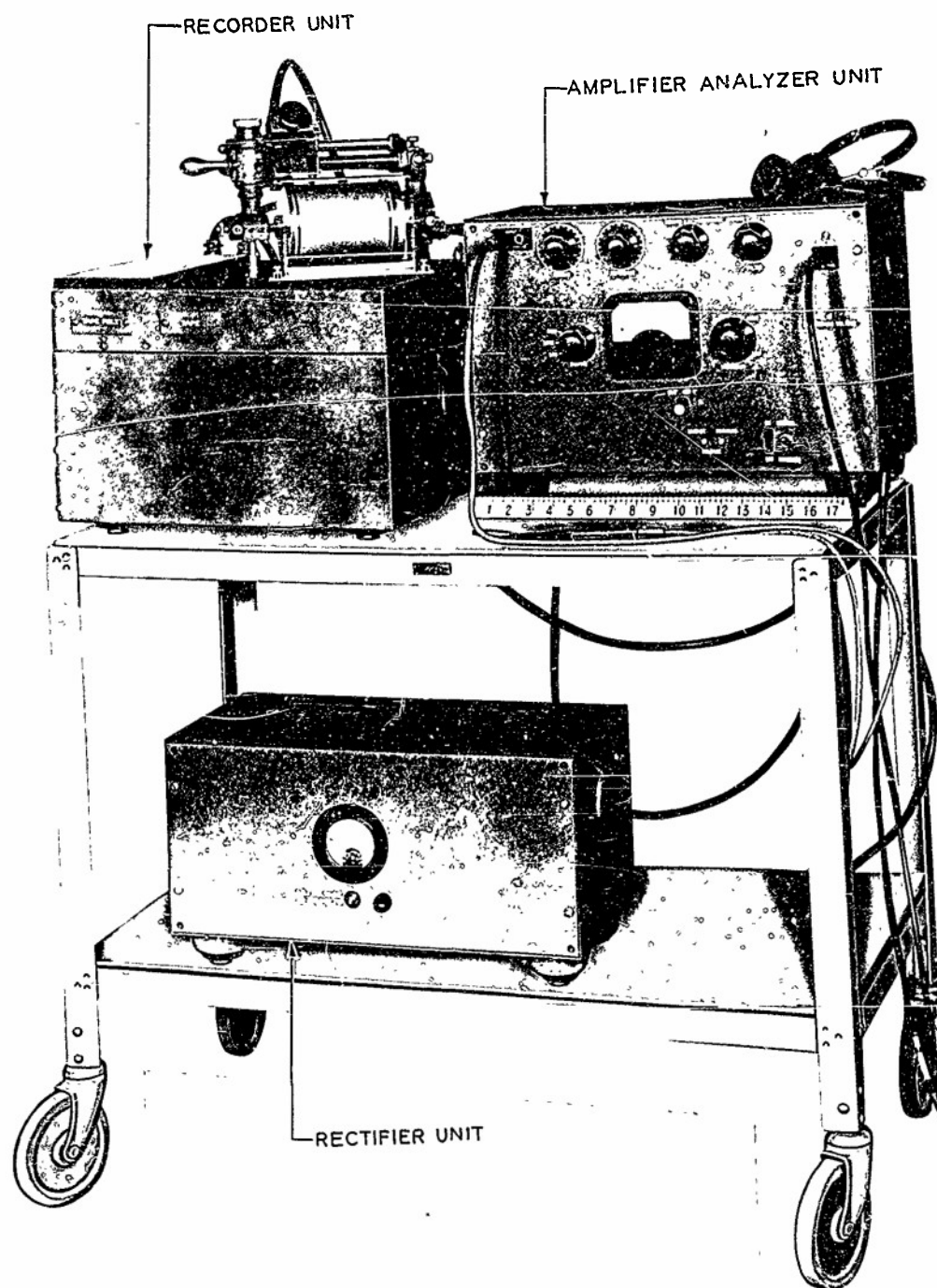
Two copies of the Operating and Maintenance Instructions for the D-165529 Sound Spectrograph have been furnished for each of the above units and one copy of these Instructions has been sent to Dr. A. F. Murray for the N.D.R.C. files as required by the contract.

Report Prepared by:

C. H. G. GRAY
Transmission Standards Engineer
Bell Telephone Laboratories, Inc.
463 West Street
New York 14, New York

Attached:
Photographs Nos.
120238
122605

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FIG.1 D165529 SOUND SPECTROGRAPH
UNITS INTERCONNECTED AND READY FOR USE

120238

SAMPLE S.E.C.I.F.O.G.R.A.M.S

FREQUENCY SCALE, 0-3500 CPS -- 1/4" SEC. -- 2.4 SECON



PATTERN WIDTH = 2" -- .5 CPS BAND PASS FILTER



PATTERN WIDTH = 2" -- .5 CPS BAND PASS FILTER



PATTERN WIDTH = 2" -- .5 CPS BAND PASS FILTER

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